Lake Stevens

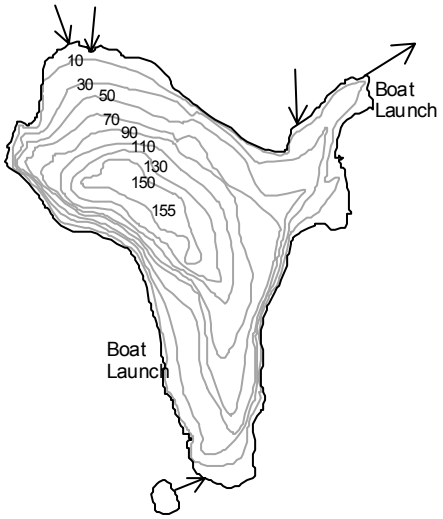
Lake Stevens has high water clarity, low nutrients, and moderate aquatic plants. In spite of the success of the aeration system, there are signs of accelerated eutrophication, such as a possible decline in water clarity and frequent blue-green algal blooms. The health of the lake appears to be at risk unless nutrients from the lake shore and the surrounding watershed are controlled.

State of the Lakes Report
March 2003

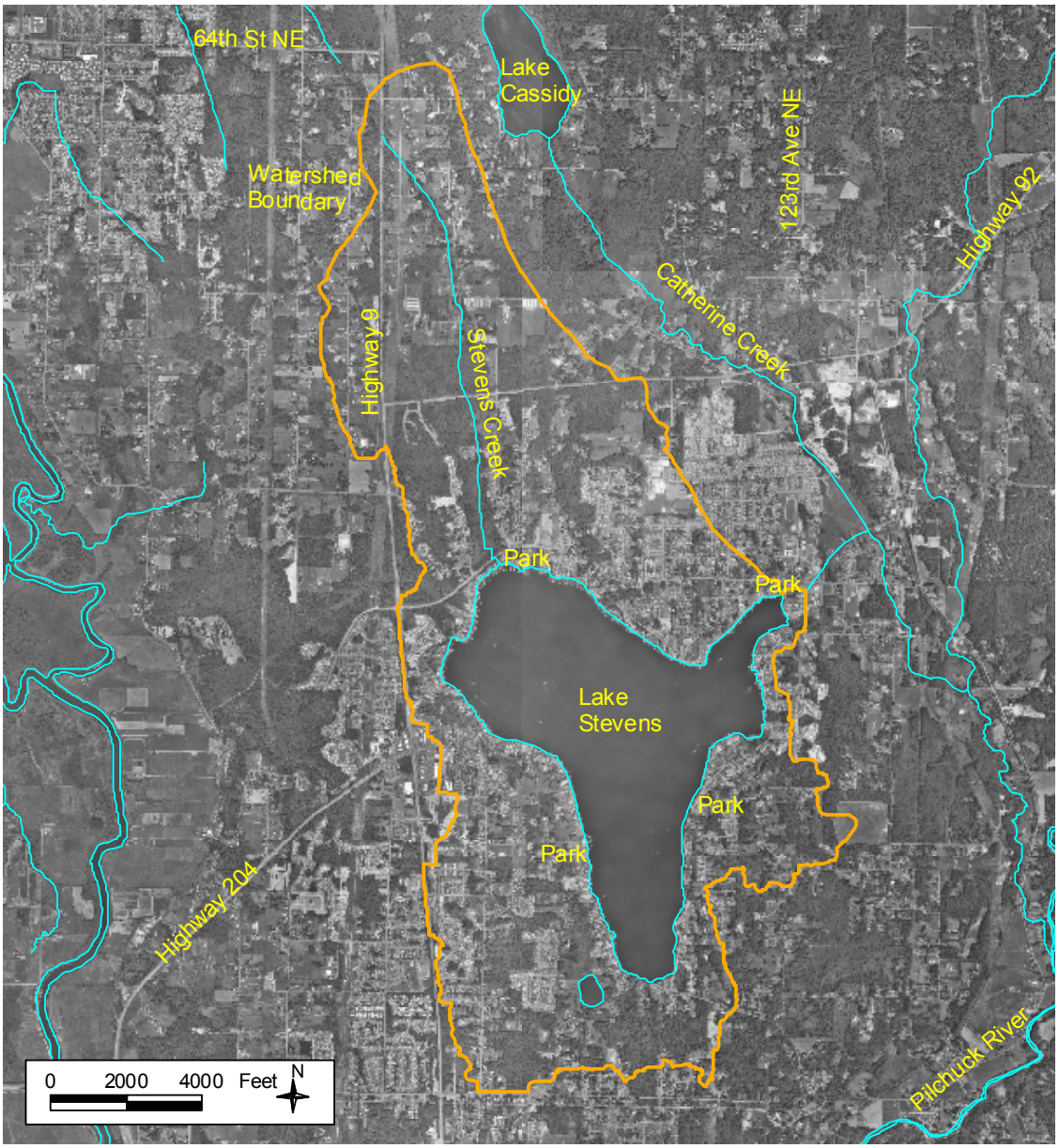
Snohomish County Public Works
Surface Water Management

LAKE AND WATERSHED DATA

Lake Area:	1040 acres
Watershed Area:	4371 acres
Watershed to Lake Area Ratio:	4.2
Maximum Depth:	155 feet (47.3 meters)
Average Depth:	63 feet (19.4 meters)
Lake Volume:	65,000 acre-feet
Length of Shore:	7.1 miles



	1972	MID-90'S
# of nearshore homes	330	349
# of homes/1000' of shoreline	8.8	9.3
% of homes with bulkhead or fill		NA
% of homes with some native vegetation near shore		NA
% of watershed developed (residential or commercial)	20%	55% (est.)



LAKE ASSESSMENT

DESCRIPTION

■ *Location/Access* – Lake Stevens is located six miles east of Everett just east of Highway 9. Stevens, Lundeen, Kokanee, and Stitch creeks are the primary sources of water feeding the lake. Lake Stevens empties into Catherine Creek which ultimately drains to the Pilchuck River. Recreational use of the lake—fishing, swimming, boating, and skiing—is very heavy. Three County parks—Wyatt, Lundeen, and Sunset—and two City of Lake Stevens parks provide public access. Boats can be launched at Wyatt Park and the City boat launch.

■ *Size/Shape* – Lake Stevens is the largest natural lake in the county at 1040 acres. The lake is also the deepest, with a maximum depth of 47 meters and an average depth of 19.4 meters. The lake holds 65,000 acre-feet of water.

■ *Watershed* – The Lake Stevens watershed covers 4371 acres. This is the largest lake watershed in the county, but it is only 4.2 times the size of the lake. This means that Lake Stevens has a very small watershed for its size and that there should be less potential for impacts from pollution coming from the surrounding lands than at a lake with a larger watershed. Conversely, a small watershed means less water coming into the lake, a longer water residence time, and less chance of pollution flushing out of the lake. The percentage of residential and commercial development in the watershed increased from about 20% in 1972 to 55% by the mid-90s. This growth is having a negative impact on lake water quality.

■ *Shoreline* – The shoreline of Lake Stevens is 7.1 miles long. Along the shoreline, there were 330 homes in 1972 and 349 by the mid-90s. Many small homes or cabins have been replaced by large, year-round homes. Lake Stevens is one of the most densely developed lakes in the county. Most of the nearshore homes have modified the shoreline with bulkheads or fill. Only a few homes have retained some native vegetation along the shore. Heavy shoreline development without buffers of native vegetation can allow pollution to reach the lake.

LAKE CONDITIONS

■ *Water Clarity* – In response to continuing water quality problems, detailed Phase I studies were conducted in 1982 (Reid Middleton) and 1986 (KCM). Summer water clarity averaged 6.0 meters in 1982 and 6.6 meters in 1986. From 1990 through 2002, summer water clarity averages ranged from 4.8 to 7.0 meters. Overall, Lake Stevens has high water clarity. However, the clarity may be declining. Analysis does not yet show a statistically significant decline in water clarity, but the values approach significance. If, in fact, a real trend toward poorer water clarity is confirmed, it might be linked to increasing development in the watershed which brings additional nutrients to the lake.

■ *Color* – The lake has very little natural color. The water is usually described as light green.

■ *Nutrients* – In 1986, the summer average total phosphorus concentration in the epilimnion was low—5 µg/l. In 1993 and from 1997 through 2001, the summer epilimnion average increased somewhat, ranging between 8 to 15 µg/l. The summer total phosphorus concentration in the hypolimnion averaged 69 µg/l during the 1986 study. This reflects substantial phosphorus release from the bottom sediments during times of oxygen depletion. In fact, the 1986 study identified internal recycling of phosphorus as the single largest source of nutrients to the lake. Subsequent sampling by Drainage Improvement District #8 has shown that the summer hypolimnion total phosphorus concentrations have fallen to between 11 and 15 µg/l in 1999 through 2001. This

reduction is no doubt the result of a hypolimnetic aeration system installed in 1994 to control internal phosphorus releases. However, higher epilimnion phosphorus concentrations and regular algal blooms indicate that the success of the aeration system cannot keep pace with continuing nutrient inflows from the watershed. Total nitrogen data during 1986-87 and from 1990-1995 showed that nitrogen concentrations were 23 to 150 times as high as phosphorus. Because nitrogen is abundant, phosphorus availability appears to be the factor limiting algal growth. Therefore, the lake continues to be listed on the State's 303(d) list as impaired due to excess phosphorus.

■ *Oxygen/Temperature* – The deepness of Lake Stevens results in extremely strong stratification between the warm, oxygenated epilimnion and the cool, oxygen-poor hypolimnion. Vertical profiles of dissolved oxygen and temperature from 1986 and the early 1990s showed that dissolved oxygen dropped rapidly below about 15 meters and that it was depleted in the bottom 10 meters of water. This indicates the presence of decomposing organic matter in the lake bottom which provides conditions suitable for phosphorus release from the sediments. However, since installation of the aeration system, oxygen in the hypolimnion rarely drops below 4 mg/l, and internal phosphorus release does not appear to be a problem.

■ *Algae* – During the summer of 1986, chlorophyll *a* averaged 4.6 µg/l, which indicates moderate algae levels. Blue-green algae dominated, while diatoms dominated during other parts of the year (except for severe blue-green blooms in spring 1987). Summer averages from 1990 through 2001 were somewhat lower, ranging from 0.5 to 4.8 µg/l. However, even in recent years, there have been regular observations of nuisance blue-green algal blooms and of attached filamentous algae growing throughout the lake. These observations correlate with the possible decline in water clarity.

■ *Aquatic Plants* – Lake Stevens supports moderate levels of aquatic plants. In some areas with steep slopes, few plants grow. However, around much of the lake and in shallow coves, plants grow prolifically. Common plants in Lake Stevens are naiad, grassy pondweed, thin-leaf pondweeds, yellow water-lily, fragrant water-lily, elodea, nitella, chara, and watershield. Eurasian watermilfoil, an invasive non-native plant, was present in the lake in the 1980s and early 1990s, but has not been found in recent years.

■ *Waterfowl* – Lake Stevens has a serious problem with excess waterfowl—ducks and Canada geese. Waterfowl droppings are unsightly and pollute the water with nutrients and bacteria.

SUMMARY

■ *Trophic State* – Based on high, but possibly declining, water clarity, low phosphorus concentrations, hypolimnetic oxygen depletion, frequent blue-green algal blooms, and moderate aquatic plants, Lake Stevens may be classified as oligo-mesotrophic.

■ *Current Conditions/Trends* – Lake Stevens is currently in satisfactory condition. However, the lake shows signs of accelerated eutrophication, such as a possible trend toward declining water clarity and regular blue-green algal blooms. For these reasons, Lake Stevens appears to be at risk of future declines in water quality.

■ *Future Concerns/Targets* – The main concern for Lake Stevens is the difficulty of maintaining good water quality in the face of continued nutrient inflows from the watershed and shoreline. It appears that restoration efforts are successfully controlling internal nutrient cycling, but that the nutrients from watershed and shoreline activities—land development, fertilizer use, road runoff, and household practices—continue to fuel algal growth in the lake. Improving water clarity and reducing phosphorus levels are targets for the lake.

■ *Recommendations* – Detailed monitoring of the lake should continue, with emphasis on nutrient inputs and algae. All new development in the watershed should take precautions to control runoff and reduce nutrient pollution. Existing homes on the lake shore and along stream channels should be encouraged to re-create buffers of native vegetation to filter out pollution before it reaches the lake. Nuisance waterfowl should be controlled. The Lake Stevens Watershed Water Quality Management Plan contains other recommendations.

CITIZEN VOLUNTEERS

Thanks to Drainage Improvement District #8 and to numerous past volunteers for monitoring the lake.

DATA SUMMARY TABLE

Source	Date	Secchi Depth (meters)	Total Phosphorus (*ug*/l)		Color (Pt-Co scale)	Chlorophyll *a* (*ug*/l)
			Surface	Bottom	Epilimnion	Epilimnion
Bortleson, et al, 1976	**7/27/72**	5.2	5	56	5	-
Reid, Middleton & Associates, 1983	Summer **1982**	3.6 - 9.0 (6.0) *n = 5*	5 - 23 (12) *n = 6*	20 - 35 (30) *n = 6*		7 - 17 (9.8) *n = 6*
KCM, 1987	Summer **1986**	5.2 - 8.8 (6.6) *n = 7*	<0.5 - 14 (5) *n = 7*	56 - 109 (69) *n = 7*	-	0.0 - 21.7 (4.6) *n = 7*
LS Volunteer or DOE	Summer **1990**	4.0 - 8.8 (6.1) *n = 25*	-	-	-	3.7 - 6.0 (4.8) *n = 2*
LS Volunteer or DOE	Summer **1991**	4.7 - 10.1 (7.0) *n = 27*	-	-	-	2.0 - 3.0 (2.5) *n = 2*
LS Volunteer or DOE	Summer **1992**	3.8 - 7.8 (5.9) *n = 25*	-	-	-	2.2 - 5.1 (3.3) *n = 3*
LS Volunteer KCM or DOE	Summer **1993**	3.9 - 8.2 (6.0) *n = 15*	4 - 12 (8) *n = 6*	33 - 85 (48) *n = 6*	-	1.3 - 4.0 (2.8) *n = 11*
DOE	Summer **1994**	3.8 - 9.5 (5.4) *n = 12*	-	-	-	1.6 - 3.0 (2.3) *n = 2*
DOE	Summer **1995**	4.6 - 9.9 (6.3) *n = 13*	-	-	-	1.0 - 4.4 (2.7) *n = 2*
DD#8	Summer **1997**	4.0 - 7.7 (5.6) *n = 6*	<2.5 - 12 (8.6) *n = 9*	40 - 66 (52) *n = 8*	-	1.4 - 9.6 (3.5) *n = 9*
DD#8	Summer **1998**	3.8 - 5.6 (4.9) *n = 8*	6.3 - 15 (8.6) *n = 6*	36 - 118 (53) *n = 6*	-	1.5 - 3.9 (2.6) *n = 6*
DD#8	Summer **1999**	3.6 - 7.3 (4.8) *n = 10*	7.8 - 15 (11) *n = 6*	6.3 - 17 (11) *n = 5*	-	0.5 - 3.2 (1.9) *n = 6*
DD#8	Summer **2000**	4.2 - 5.9 (4.9) *n = 9*	6.5 - 14 (10) *n = 5*	9.2 - 23 (15) *n = 5*	-	0.3 - 1.1 (0.7) n = 5
DD#8	Summer **2001**	3.6 - 6.6 (5.1) *n = 11*	11 - 18 (15) *n = 6*	11 - 21 (14) *n = 6*		0.2 - 1.2 (0.5) n = 5
DD#8	Summer **2002**	4.8 - 10 (6.4) *n = 12*	-	-	-	-

NOTES

- Table includes summer (May-Oct) data only.
- Each box shows the range on top, followed by summer average in ( ) and number of samples (n).
- Total phosphorus data are from samples taken at discrete depths only.
- DOE = Washington Department of Ecology
- LS Volunteer = citizen volunteer monitors involved in the Lake Stevens Restoration Program
- DD#8 = Lake Stevens Drainage Improvement District #8

SUMMARY OF OTHER DATA

■ *Total Phosphorus* – composite samples taken by the Department of Ecology in 1990 and 1992-1995 ranged from 7 -- 27 µg/l (average 14 µg/l) in the epilimnion and from 9 -- 45 µg/l (average 22 µg/l) in the hypolimnion. Composite samples collected by LS Volunteers and KCM in 1990-1993 ranged from 5 – 39 µg/l (average 21 µg/l) in the epilimnion and from 17 – 47 µg/l (average 30 µg/l) in the hypolimnion. These values from composite total phosphorus samples are not directly comparable to the discrete samples shown above. In addition, the composite depths used by Ecology and LS Volunteers were not the same. However, these composite sample data indicate that Lake Stevens has moderate phosphorus levels.

■ *Nitrogen* – single total nitrogen samples in 1972 showed 0.48 mg/l in the epilimnion and 1.04 mg/l in the hypolimnion; during KCM's 1986-87 study, total nitrogen levels were moderate, ranging from 0.325 – 1.690 mg/l in the epilimnion, with an average of 0.519 mg/l, and from 0.447 – 1.387 mg/l in the hypolimnion, with an average of 0.650 mg/l; nitrate was moderate (up to 0.34 mg/l) and ammonia was low (up to 0.10 mg/l); Ecology total nitrogen composite samples from 1990-1995 averaged 0.33 mg/l in the epilimnion and 0.49 mg/l in the hypolimnion; these data suggest that nitrogen is abundant and is not limiting algal growth.

■ *Alkalinity* – data from the 1986-87 study ranged from 28 -- 34 mg/l $CaCO_3$, which indicates that Stevens has a moderate buffering capacity compared to other Snohomish County lakes.

■ *pH* – 1986-87 study data averaged 7.4 in the epilimnion and 6.7 near the lake bottom, with occasional peaks up to 8.5 during algal blooms; these values are near neutral and typical for Snohomish County lakes.

■ *Conductivity* – 1986-87 data averaged 77 µmhos near the surface and 72 µmhos near the lake bottom; these data indicate moderate levels of dissolved materials in the water.

■ *Algae* – samples collected during the 1986-1987 KCM study showed that spring 1986 had moderate biovolumes dominated by diatoms. From May through mid-October, biovolumes remained moderate with diatoms dominating in early summer and blue-greens being dominant in late summer. From fall 1986 through spring 1987, diatoms again dominated through January, but vigorous blue-green blooms with high biovolumes occurred in February and March.

	Averages		
ALGAE TYPES	Feb.-March 1986	May-Oct. 1986	Nov.-March 1986-1987
Cyanophyta (Blue-greens)	0%	44%	48%
Chlorophyta (Greens)	1%	14%	1%
Chrysophyta (Golden/diatoms)	92%	34%	45%
Cryptophyta (Cryptomonads)	5%	6%	4%
Euglenophyta (Euglenoids)	1%	0%	0%
Pyrrhophyta (Dinoflagellates)	1%	3%	1%

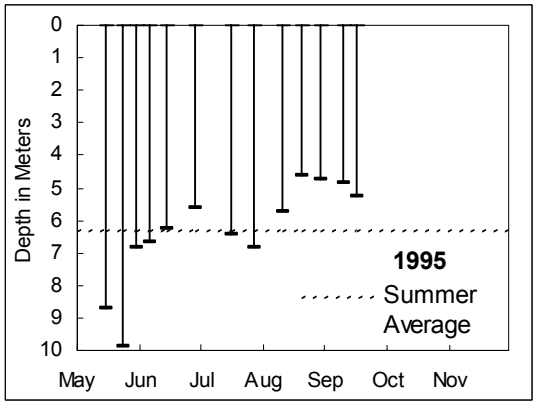
■ *Fish* – according to the Washington State Department of Fish and Wildlife (WDFW), fish species found in Lake Stevens include rainbow trout, cutthroat trout, kokanee, largemouth bass, smallmouth bass, black crappie, yellow perch, and brown bullhead catfish.

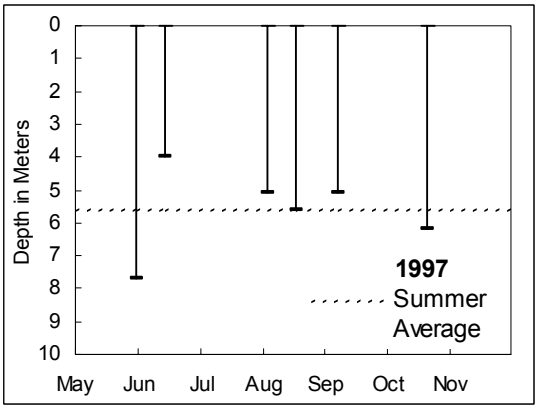
DATA SOURCES

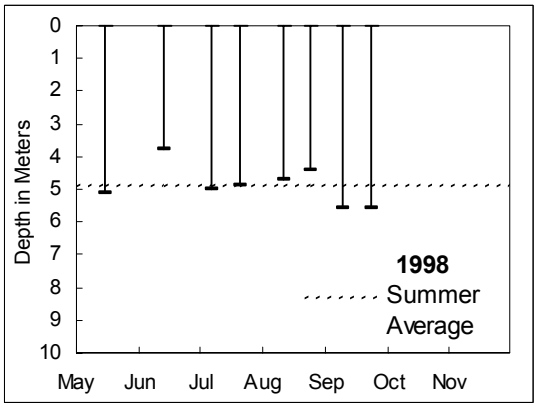
In addition to data from Snohomish County SWM staff and citizen volunteers, data for Lake Stevens are also available from: Bortleson, et. al., 1976; KCM, 1987; KCM, 1994b; Rector, 1994; Rector, 1996; Reid, Middleton & Associates, 1983; and Smith and Rector, 1997. Drainage Improvement District #8 monitoring data are available in Gray & Osborne, 1998; Gray & Osborne, 1999; Gray & Osborne, 2000; Gray & Osborne, 2001; and Gray & Osborne, 2002. Please refer to the full list of references in the County-Wide Summary.

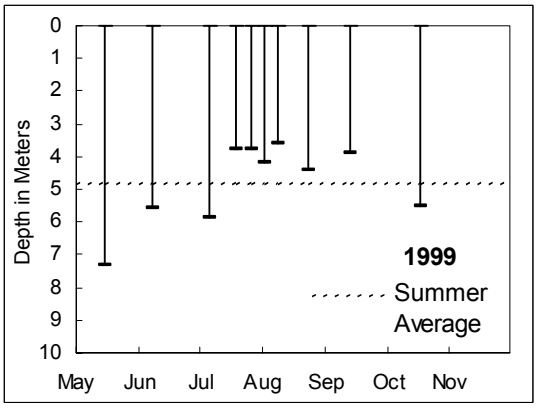
Click here to view more recent data.

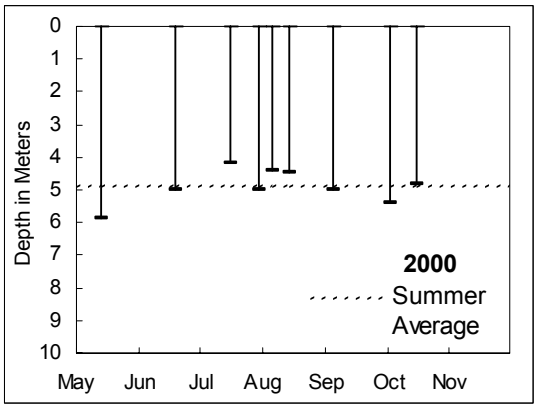
WATER CLARITY



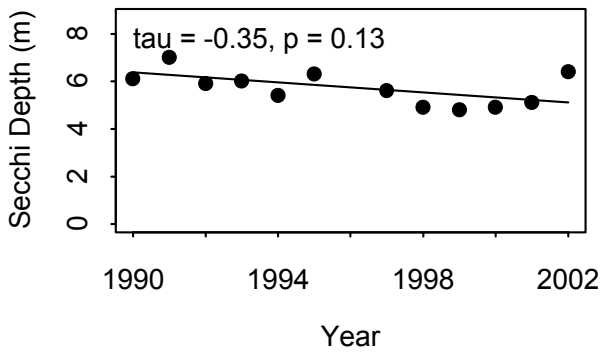




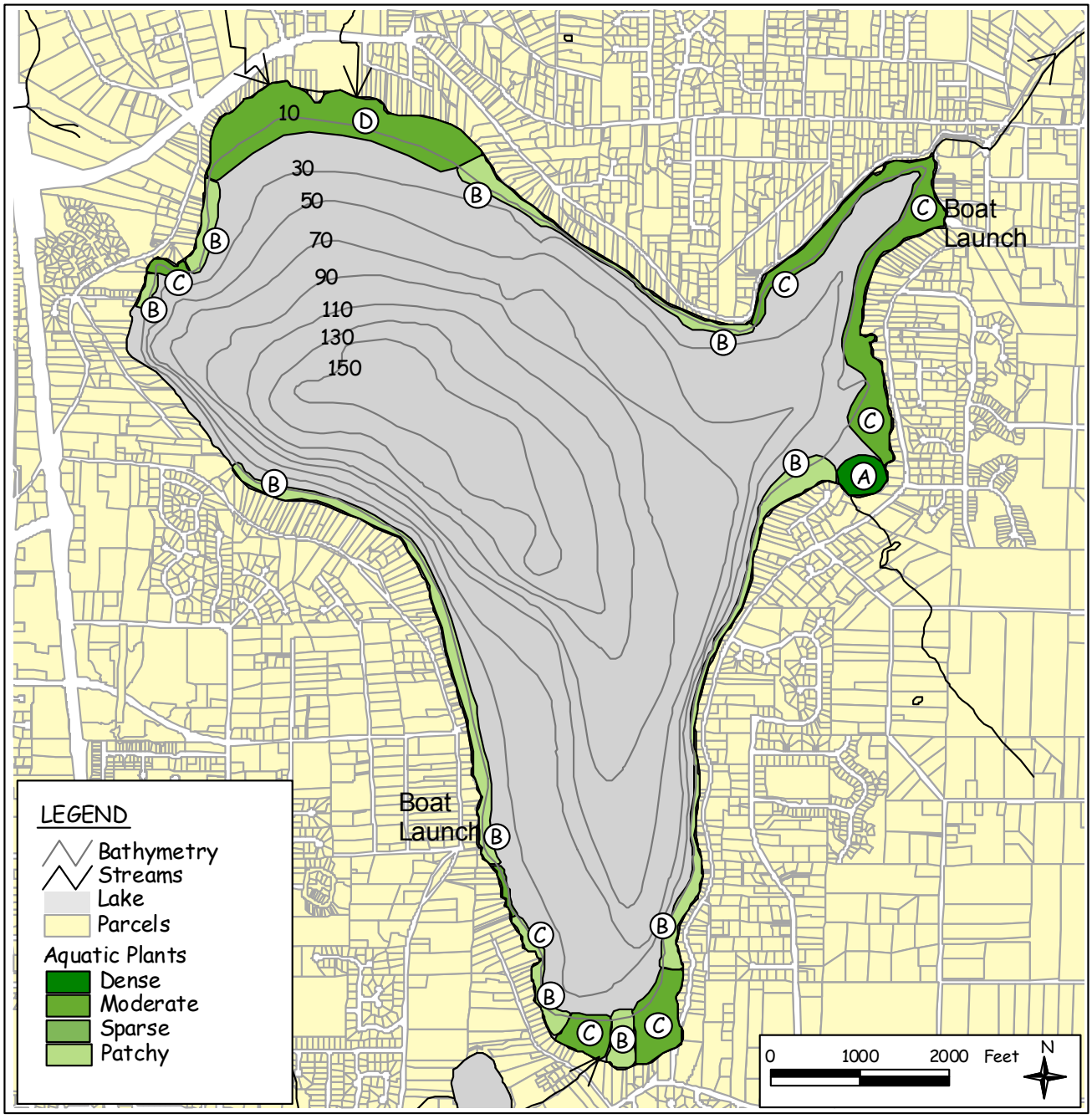




TREND ANALYSIS



AQUATIC PLANTS



Area	Density	Dominant Plants	Other Plants
A	Dense	*Brasenia schreberi* (Watershield) *Nymphaea odorata* (Fragrant water-lily)	*Nuphar polysepalum* (Yellow water-lily)
B	Sparse	*Potamogeton sp.* (Thin-leaf pondweed) *Potamogeton gramineus* (Grassy pondweed)	*Elodea canadensis* (Common elodea) *Najas flexilis* (Water-nymph, Naiad) *Nuphar polysepalum* (Yellow water-lily) *Chara sp.* (Stonewort, Muskgrass)
C	Moderate	*Elodea canadensis* (Common elodea) *Potamogeton sp.* (Thin-leaf pondweed) *Potamogeton gramineus* (Grassy pondweed) *Najas flexilis* (Water-nymph, Naiad)	*Nuphar polysepalum* (Yellow water-lily) *Chara sp.* (Stonewort, Muskgrass)
D	Moderate	*Potamogeton sp.* (Thin-leaf pondweed) *Potamogeton gramineus* (Grassy pondweed) *Nitella* sp. (Brittlewort)	*Elodea canadensis* (Common elodea) *Najas flexilis* (Water-nymph, Naiad)

HOW YOU CAN HELP LAKE STEVENS

- Educate yourself about lake ecology and the lake's health.
- Use lawn and garden fertilizers sparingly; test your soil first; choose low or no phosphorus fertilizers.
- Retain or plant native vegetation adjacent to the water to protect the shoreline and filter pollution.
- Infiltrate or filter the runoff from rooftops, patios, and driveways rather than piping it to the lake.

- Cover or mulch bare soil areas.
- Use pesticides, herbicides, and household chemicals sparingly and never near the water.
- Maintain your septic system—have it inspected every two years and pumped when needed.
- Conserve water both inside and outside.
- Clean up pet wastes and keep livestock away from the lake shore.

- Learn to identify non-native invasive aquatic plants and animals; check your boat and trailer for invaders; never empty an aquarium into the lake.
- Do not feed geese or ducks.
- Join with neighbors or the local property owners' association to work together to protect the lake.

Contact Snohomish County Surface Water Management at 425-388-3464 for information about these topics or if you have questions about Lake Stevens.

(TTY users call 425-388-3700)

Snohomish County
Public Works
Surface Water Management

Working together for people, streams & fish.